Section 25.253(a)(8). To the contrary, Section 25.253 of the Commission's Rules, and paragraph 142 of the *ATC Order*, establish different and separate key parameters under which ATC must operate in order to limit interference to MSS systems in the L-Band.

First, Section 25.253(a)(8) and paragraphs 140 and 142 of the *ATC Order* expressly mandate that an L-band ATC system must be designed with at least an 18 dB link margin *allocated for structural attenuation.* The Commission acknowledged in paragraph 140 of the *ATC Order* that this power limitation requirement embodies a critical technical assumption underlying the Commission's evaluation of potential interference into Inmarsat's network, and therefore underlying the Commission's decision to allow ATC in the L-band.[43] This requirement obligates the L-Band ATC applicant to demonstrate how it will comply to ensure that its ATC system does not exceed the interference level assumed in the Commission's analysis.

Second, after twice discussing the 18 dB structural attenuation factor, the Commission continued on to adopt a distinct and separate requirement, "*in addition,* MSS licensees shall not extend the coverage area of any ATC cell beyond the point where an ATC MT could operate at the edge of coverage of the ATC cell with a maximum EIRP of -[18] dBW."[44] The Commission would not have used the words "in addition" to introduce the edge of cell coverage prohibition if all it were doing was repeating a requirement already discussed twice before. Thus, the Bureau's suggestion that the "underlying intention" of the structural attenuation limitation "was to bar licensees from extending a base station's edge of coverage"[45]

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[43] "Our analysis assumes . . . that the link budget for ATC reserves a minimum of 18 dB for structural attenuation . . . .". *See also ATC Order* at 2035, 2152 (Appendix C2 § 1.3.5) ("analyses is based on the expectations that MSV will implement the full 18 dB of margin for structural attenuation that they state is 'per standard PCS design practices'").

[44] *See ATC Order* at 2036 (emphasis supplied). There is a typographical error in paragraph 142 of the *ATC Order*, which Inmarsat has requested be corrected, and which the Bureau recognized as an error in footnote 60 of the *MSV Order*. The *ATC Order* references a 10 dB margin when it meant an 18 dB margin.

[45] *MSV Order* at ¶ 32.

is belied by the Commission's own explanation in the *ATC Order*.

There are ways that MSV could comply with both the letter and intent of the Commission's rules. For example, in order to ensure that an ATC mobile terminal automatically operates at a lower transmit power when outdoors, the terminal could contain a built-in GPS receiver in the handheld. If the mobile terminal "sees" any GPS satellite, it would assume that it is operating outdoors. The indoor/outdoor information would be constantly reported (embedded in the signalling) to the terrestrial base station, where it could be monitored and recorded.

Inmarsat objected to MSV's failure to comply with the structural attenuation requirement and the edge-of-cell limitation. Appendix E of MSV's November 18, 2003 *ATC Application* provides merely a description of one *possible* measure that MSV *might* be able to employ to ensure compliance with this rule. MSV's explanation is replete with the carefully chosen words "can design" and "may be configured." No where does MSV commit to implement any of the described measures or any of the other "variety of ways" that MSV refers to but does not explain or even describe.[46] Worse yet, it is not even clear that MSV *will* comply. MSV states to the contrary: "If less structural attenuation is used, the maximum number of base stations permitted under Section 25.253(a)(9) will be reduced or a showing will be made that there would be no increase in interference to other MSS operators . . . ."[47] But we do not know how that will be accomplished, or whether MSV's solution will be adequate.

Thus, the Commission has no way of knowing how MSV will comply with its rules. The vague statements that MSV made are hardly the "demonstration" mandated by Section 25.253(a)(8). Nor should a mere certification by MSV suffice. Just last year, in the context of revising its satellite licensing rules, the Commission rejected the idea that a licensee

[46] As discussed in Inmarsat's Opposition, the one method that MSV describes fails to ensure that all terminals operating outdoors will reduce their maximum EIRP by at least 18 dB.

[47] *ATC Application* at 15-16.

should be able to merely certify compliance with a license milestone.[48] The same result should obtain here, where the economic interests of the licensee are contrary to the dictates of the rule.

C. The Bureau Erred in Allowing Increased ATC Base Station Power and Relaxing Base Station Antenna Performance Requirements

In granting MSV's requested waivers to increase ATC base station EIRP by a factor of 6.3 (8 dB) and also to deploy lower performance base station antennas, the Bureau committed three errors: (i) it miscalculated the impact of the waivers and failed to take into account the combined interference effect resulting from the grant of both waivers, (ii) it failed to adequately address the increased intermodulation effects that would result from the power increase, and (iii) it simply ignored objections that Inmarsat raised and evidence that Inmarsat presented.

As an initial matter, for the reasons provided in Section III.A. above, allowing MSV to deploy "high powered" ATC base stations significantly expands the size of the "exclusion zones" around an ATC base station where an Inmarsat mobile terminal will not work. This affects the deployment of land mobile MSS service by punching "swiss cheese" holes throughout Inmarsat's service area in the United States. Section 1.2 of the Technical Annex explains why the Commission's calculation substantially understates of the size of these zones.

These waivers also present problems for the deployment of aeronautical MSS terminals. As set forth in Section 1 of the Technical Annex, the base station power increase waiver and the base station antenna performance waiver are integrally related and combine to increase the potential interference into Inmarsat aeronautical terminals. This is a significant problem because it could result in interference to Inmarsat broadband services being provided to airplanes, even those far away from airports. In its Opposition, Inmarsat explained the serious threat to its aeronautical receivers posed by higher-power ATC base station operations. Inmarsat

[48] *In the Matter of Amendment of the Commission's Space Station Licensing Rules and Policies and Mitigation of Orbital Debris*, 18 FCC Rcd 10760, 10831 (2003).

explained that MSV's analysis in its *ATC Application* was flawed, and, as a result, the aggregate power limit per MSV base station sector should be significantly lower than MSV advocated. Specifically, Inmarsat asked the Commission not to allow MSV to increase the power of its ATC base stations, to deny MSV's request for a waiver of § 25.253(d)(1) and instead, to reduce the base station power from that specified in the current ATC rules.[49]

Without so much as an explanation, the Bureau simply disregarded Inmarsat's analysis and a test report from Inmarsat's manufacturer, NERA. The Bureau makes a passing comment that Inmarsat did not respond to MSV's subsequent request for a partial power increase, rather than a full power increase,[50] which observation is wholly irrelevant because Inmarsat opposed *any* power increase, and actually explained that a power *reduction* was warranted. Then, the Bureau simply requires MSV to "notify" Inmarsat if MSV would operate above the power limit of the current rules, and indicates that it expects MSV and Inmarsat to "work together" to resolve any intermodulation problems.[51] Similarly, the Bureau ignored evidence from Honeywell about the receive sensitivity of Inmarsat aeronautical terminals, and simply reasserted that the existing rules provide an adequate margin against overload of an airborne MET receiver. [52]

Inmarsat raised serious interference issues and supported its assertions with technical explanations and a test report. The law is clear that the Commission cannot summarily sweep aside such objections, and the failure to do so is reversible as arbitrary and capricious.

Moreover, attempting to sidestep the intermodulation problem by referring the matter to coordination between the parties is inconsistent with the policy determination discussed

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[49] *Inmarsat Opposition* at 51.

[50] *MSV Order* at ¶ 13.

[51] *Id.* at ¶ 82.

[52] *Id.* at ¶ 80.

above that ATC is a secondary service, the determination that variations from the baseline ATC architecture are permissible only if that they do not result in greater potential interference, and the requirement that MSV modify its ATC operations if interference does occur.

In any event, coordination here is likely to be futile. As Inmarsat informed the Commission in October 2001, since 1998, MSV and its predecessors have delayed and impeded the negotiation of a spectrum operating agreement under auspices of the Mexico City MOU, and thus have prevented the reassignment of spectrum among the parties. Since MSV has dragged its feet and refused to negotiate while it awaits Commission action on ATC, there is no reason to think MSV would make any concessions to Inmarsat to reduce the interference impact of its ATC operations.

D. The Bureau Erred in Taking into Account Average ATC Mobile Terminal Antenna Gain

The Bureau has granted a relaxation of the 1725 co-channel reuse limit that is critical for constraining interference into Inmarsat spacecraft. The Bureau based its decision on MSV's claim that an ATC mobile terminal's *average* antenna gain should be used in the interference calculations instead of the *peak* antenna gain specified in the ATC rules. Thus, the Bureau waived the strict application of Section 25.253(g)(1), which expressly requires that the ATC mobile terminal be limited to a peak power level with which MSV admittedly does not comply. The Bureau reasoned that even though peak power was used to determine the co-channel reuse limits in Section 25.253(g)(1), the underlying purpose of that provision is satisfied by taking into account the average power of MSV's mobile terminals.[53]

The Bureau erred in granting this waiver in isolation, and not taking into account offsetting factors. Altering or waiving one ATC parameter affects the margin available to accommodate other variables in the Commission's ATC interference analysis. Indeed, given that

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[53] *MSV Order* at ¶ 56.

there are degrees of uncertainty surrounding many of the Commission's assumptions about ATC interference, the Commission has decided to phase in its ATC co-channel reuse limits over time. As set forth in Section 2.2 of the Technical Annex, a number of variables could increase the actual ATC interference experienced by Inmarsat. For example, and as discussed above, the Commission has failed to account in its uplink interference analysis for two Inmarsat orbital locations that will be much more susceptible to interference than the Commission has assumed, and whose effect would almost entirely offset the average antenna gain factor the Commission has identified.

It is manifestly unfair for the Bureau to "refine" its interference assessment by taking into account only the factors that favor MSV. If a renewed approach to the interference analysis is to be taken, then it must include a range of other issues, such as those identified in Section 2.2 of the Technical Annex, which will negate, and possibly outweigh, the advantages of using an ATC mobile terminal's *average* antenna gain. The Bureau's decision to ignore Section 25.253(g)(1), and its selective use of new technical data, are unjustified and should be reversed.

IV. CONCLUSION

For the reasons discussed above, Inmarsat requests that the Commission reverse the Bureau's decision in this matter.

Respectfully submitted,

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Appendix A

Technical Annex – December 8, 2004

1. Downlink Interference Issues

The waivers of the ATC rules in the International Bureau's order granting ATC authority to MSV substantially increase the risk of harmful interference into aeronautical, maritime and land mobile terminals that seek to communicate over the Inmarsat system.[1] In simple terms, the relaxation of the base station EIRP limit increases interference levels to Inmarsat mobile terminals in the vicinity of ATC base stations by 8 dB. Furthermore, the relaxation of the overhead antenna gain suppression increases interference levels to aeronautical earth stations by an additional 8 to 10 dB.

In the *ATC Order*, the Commission adopted a level of protection for Inmarsat mobile earth terminals that ensures that Inmarsat services can continue to be deployed without harmful interference from ATC.[2] The Commission wisely determined that due to the inherent uncertainty in the technical analyses that had been performed, and "recognizing the importance of providing adequate interference protection to Inmarsat, and in particular the safety-related services it provides to ships and aircraft," it was constraining the deployment of ATC base stations to 50% of its maximum permitted level during an initial 18-month, phase-in period, and that such a limitation would provide an additional 3 dB of protection for Inmarsat during initial deployment, and would permit Inmarsat and MSV to study whether any interference has resulted, giving enough time to observe any seasonal variations and to analyze the results of the study.[3]

In light of this policy, and the technical analysis provided below, there is no basis for relaxing those protections now, in order to allow MSV to operate ATC base stations at 6.3 times (i.e., 8 dB) the power previously permitted, and to also effectively increase the level of interference generated toward aircraft that use or will use Inmarsat service by a factor of up to 63 times (i.e., up to 18 dB).

As an initial matter, the Bureau was wrong when it asserted that Inmarsat did not object to the 8 dB relaxation of the base station EIRP limit.[4] Inmarsat's position could not have been clearer—in addition to opposing an increase in ATC base station power, Inmarsat twice urged the Bureau to *reduce* permitted ATC base station power:

> [T]he current limit in § 25.253(d)(1) should in fact be reduced by 15 dB, rather than increased by 15 dB as MSV proposes. As a result of the above, Inmarsat

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1 *In re Applications of Mobile Satellite Ventures Subsidiary LLC*, DA 04-3553 (rel. Nov. 8, 2004) ("*MSV Order*").

2 *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, 18 FCC Rcd 1962 (2003), *Errata*, IB Docket Nos. 01-185 and 02-364 (March 7, 2003), *on reconsideration*, FCC 03-162 (July 3, 2003) ("*ATC Order*").

3 *Id.* at 2036).

4 *MSV Order* at ¶¶ 13, 78.

> urges that the Commission deny MSV's waiver request and proposes that MSV comply with an aggregate EIRP limit per base station sector of 8.9 dBW, and not 38.9 dBW as proposed by MSV.[5]

Inmarsat then re-emphasized its point:

> Inmarsat urges that the Commission deny MSV's waiver request and adopt an aggregate EIRP limit towards the horizon of 3.9 dBW, which is 15 dB less than the current rule, as requested in Inmarsat's Petition for Reconsideration.[6]

Thus, Inmarsat disagreed with any proposed increase in MSV's ATC base station EIRP. In the context of this proceeding, Inmarsat has presented analyses from two of its manufacturers---NERA and Honeywell---demonstrating the susceptibility of the Inmarsat METs to high-level, adjacent-band signals from L-band ATC base stations.[7] In fact, based on test data and analysis that Inmarsat submitted about the interference susceptibility of its mobile terminals, Inmarsat urged that ATC base station power limits be tightened rather than relaxed, and that MSV's waiver requests be denied.

The Bureau's relaxation of certain ATC base station limits is also unfounded for the following reasons:

1.1. <u>Relaxation of the overhead gain suppression of the ATC base station antennas.</u>[8]

There is no basis for granting MSV's request for a waiver to relax overhead gain suppression requirements by 8 and 10 dB from maximum gain for angles between 30° and 145°. MSV argued that such a significant increase in the interfering signal level as this would produce only 0.03 dB additional interference to airborne Inmarsat terminals. Clearly, when an aircraft is at a location in the sky, relative to an MSV base station, that corresponds to the angular range 30° to 145° from maximum gain, then the increase in interference from that base station will be between 8 and 10 dB, and not 0.03 dB. This is indisputable. MSV's assertion of a mere 0.03 dB increase is based on its calculations of the aggregate effect of 1000 ATC base stations within a circle of 50 mile radius centered on the aircraft, withthe aircraft at an altitude of 1000 ft (302 m).

What neither MSV nor the Bureau recognized is that at lower altitudes fewer ATC base stations would be visible by the aircraft, and the relative interference effect of the base stations below the aircraft would be greater. Therefore, Inmarsat's calculation considers only the case of a single ATC base station causing interference to an airborne receiver, not because this is the worst case situation, but because, if it demonstrates a potential interference problem, then the aggregate affect of multiple base stations would certainly create an even greater problem. For the case of a single base station, the reduction of 8 to 10 dB in the overhead gain suppression of the ATC base station antenna results in a corresponding 8 to 10 dB increase in the interference.

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5 *Opposition of Inmarsat Ventures Ltd* at 51 (filed Mar. 25, 2004) ("*Inmarsat Opposition*").

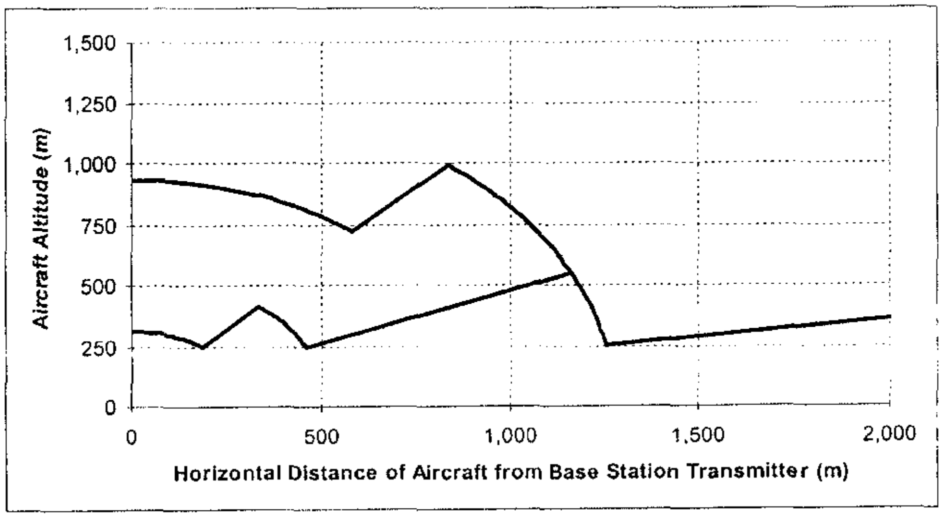
6 *Id.* at 52.

7 *Id.* at Appendices B and C.

8 *MSV Order* at ¶¶ 69-71.

In its ATC opposition in March 2004, Inmarsat demonstrated, by analysis of a single ATC base station, the impact on aircraft of granting this waiver---the resulting increase in the safe height an aircraft would need to maintain above an ATC base station.[9] The key result is shown in Figure 1 below, which clearly shows in the upper line (for horizontal distances less than approximately 1,200 meters) the increased safe distance of the aircraft from the base station resulting from grant of the requested overhead gain suppression waiver, compared to the lower line which gives the safe distance assuming compliance with the gain suppression values and other limits in the ATC rules. Note that, for the situation analyzed in Figure 1, for horizontal distances greater than approximately 1,200 meters and altitudes greater than approximately 500 meters, the ATC base station antenna gain is not affected by the proposed relaxation. Although the Bureau accurately summarized this analysis at one point,[10] it subsequently dismissed these results based on its determination that this represented an "unexplained contention" by Inmarsat.[11]

Figure 1: Impact of Relaxing the Overhead Gain Suppression of the ATC Base Stations *on the Safe Distance of an Aircraft from the ATC Base Station (-75 dBm interference threshold)*



Inmarsat's analysis and position on this matter cannot be ignored as "unexplained". It was clearly presented in Inmarsat's opposition and it was derived from a straightforward calculation of the interfering signal arriving at the aircraft from the base station. The assumptions about the interference susceptibility of the Inmarsat receiver were also clearly stated to be -75 dBm at its input, as supported by the report from Honeywell that Inmarsat included as Appendix C to its Opposition.

Nor did the Bureau explain how this technical analysis of interference into licensed services is "outweighed" by comments in favor of the waiver request filed by NTIA.

9 *Inmarsat Opposition* at 59-60.

10 *MSV Order* at ¶ 70.

11 *Id.* at ¶ 71.

NTIA may speak for the FAA and other Federal executive branch agencies, but NTIA does not represent the interests of commercial and private aircraft operators who use or will use current or future Inmarsat aeronautical services. Furthermore, the analysis on which NTIA based its assessment assumes an interference threshold of -50 dBm based on the 1 dB compression point of the receiver LNA alone, and totally ignores the appropriate interference threshold when intermodulation product interference is taken into account.[12]

Inmarsat has already provided in the record an expert assessment from Honeywell, which manufactures aeronautical Inmarsat receivers, that explains why the -50 dBm level that NTIA is still using in its analysis is simply not appropriate in assessing when the Inmarsat receiver will fail to function correctly. Specifically, Honeywell provides the correct interpretation of the ARINC specifications to which NTIA refers. ARINC Characteristics are not mandatory specifications but suggested avionics implementation guidelines primarily to foster interchangeability. Some manufacturers develop products conforming to the Characteristics; others do not. The RTCA minimum performance standards DO-210D is the only set of mandatory specifications and nothing in those specifications requires an AMS(R)S receiver to function normally with an interference level as high as -50dBm. Therefore, NTIA's conclusions in this regard are simply wrong.

The Commission expressed the view that -50 dBm is the relevant interference threshold for aeronautical terminals.[13] While Inmarsat disagrees with this, as explained above, it is important to note that significant interference problems would occur, even using an interference threshold of -50 dBm, when the combined effects of the two proposed base station relaxations (base station EIRP increased by 8 dB and base station antenna gain suppression relaxed by 8 to 10 dB), are taken into account. The Bureau failed to address this critical combination of relaxations, which compound on each other in terms of the safe distance of the aircraft from the ATC base station, as explained in the next section.

1.2. Relaxation of the ATC base station EIRP limits.[14]

The Bureau failed to consider the cumulative effect of the waivers it has granted. The Bureau argued that the situation of interference to Inmarsat's maritime and airborne METs is unchanged by the 8 dB increase in permitted base station EIRP because of the corresponding increase in the required separation distances and the maintaining of the PFD limits at the boundary of navigable waterways and at all airport runways, taxiways, landing paths and stand areas.[15] This is true, to a point. But the Bureau failed to take into account the situation of airborne METs that are on aircraft in flight, and either on approach routes or take-off routes, and which are now cumulatively affected by the waivers granted in the Order. The 8-10 dB relaxation in the ATC base station overhead gain suppression (addressed in Section 1.1 above),

12 Letter (with attachment) from Frederick R. Wentland, Associate Administrator, NTIA Office of Spectrum Management, to Edmond J. Thomas, Chief, FCC Office of Engineering and Technology, at 5, dated April 21, 2004.

13 *ATC Order* at 2038-2039.

14 *MSV Order* at ¶¶ 76-84.

15 *Id.* at ¶ 80.

combined with the 8 dB increase in the ATC base station EIRP limits, will dramatically increase the required safe separation distance between aircraft in flight and ATC base stations.

The combined effect of these two waivers poses a significantly increased threat of interference to aircraft when they are at relatively high altitudes and horizontal distances from the airports. The proposed compensating increase in separation distances from airports, or the maintaining of PFD limits at airports, will do nothing to solve the increased problems of interference to aircraft in flight.

The results of the combined effect of the Bureau's waiver grants are shown in Figures 2 and 3 below, where the necessary separation distances are given in terms of the altitude and horizontal distance from the aircraft to the ATC base station, as for Figure 1 above. Figure 2 assumes the -50 dBm interference threshold level that the Bureau proposes to use for this analysis. Figure 3 shows the same information, but with the -75 dBm interference threshold that Inmarsat believes should be used based on data from its manufacturers, as previously presented. On both of these Figures, Case 1 is the result using the limits in the ATC rules. Case 2, which only differs from Case 1 over a limited horizontal separation distance, is the result when the ATC overhead antenna gain suppression is relaxed by the 8-10 dB. Case 3 is the result when the ATC overhead antenna gain suppression is relaxed by the 8-10 dB *and* the ATC base station EIRP is relaxed by 8 dB. Note that in both Figure 2 and Figure 3 there is a dramatic increase in the vertical distance separation required when the aircraft is over the ATC base station.

In assessing the results in Figures 2 and 3 we must keep in mind that these results are for the interference from a single ATC base station only, and that the aggregate interference from more than one ATC base station, which will likely occur simultaneously, as assumed by the Commission in the *ATC Order*, will be correspondingly worse. With this in mind, Figure 2 already shows a significant interference problem, despite the assumption of a very high interference threshold (-50 dBm). In fact, even without any change in the FCC limits, the interference distance to aircraft at an altitude of 90m is greater than the distance limitation of 470m. With the relaxations in base station EIRP and overhead gain suppression, harmful interference will occur from a single ATC base station when the aircraft altitude is less than 190 meters (623 ft) and at horizontal distances up to 2,250 meters (1.4 miles). The results in Figure 3, which assumes the interference threshold of -75 dBm, as evidenced by Inmarsat's aeronautical terminal manufacturers, are very much worse, with interference problems occurring at aircraft altitudes up to 2,800 meters (1.7 miles) and horizontal distances up to 40 km (25 miles). Clearly, the FCC's proposed distance separation limits and PFD limits relative to airports, even if these are modified to account for any correction in the interference threshold, will have absolutely no impact on overcoming the interference caused by the combination of relaxing the overhead gain suppression requirements and increasing ATC base station EIRP. These results demonstrate that the combination of the two relaxations proposed by the Bureau would have a serious impact in terms of interference into airborne terminals. Therefore, it is essential that the Commission correct the error made in granting the waivers to MSV.

Figure 2: Impact of Relaxing the Overhead Gain Suppression of the ATC Base Stations, and Increasing its EIRP by 8 dB, on the Safe Distance of an Aircraft from the ATC Base Station (-50 dBm interference threshold)

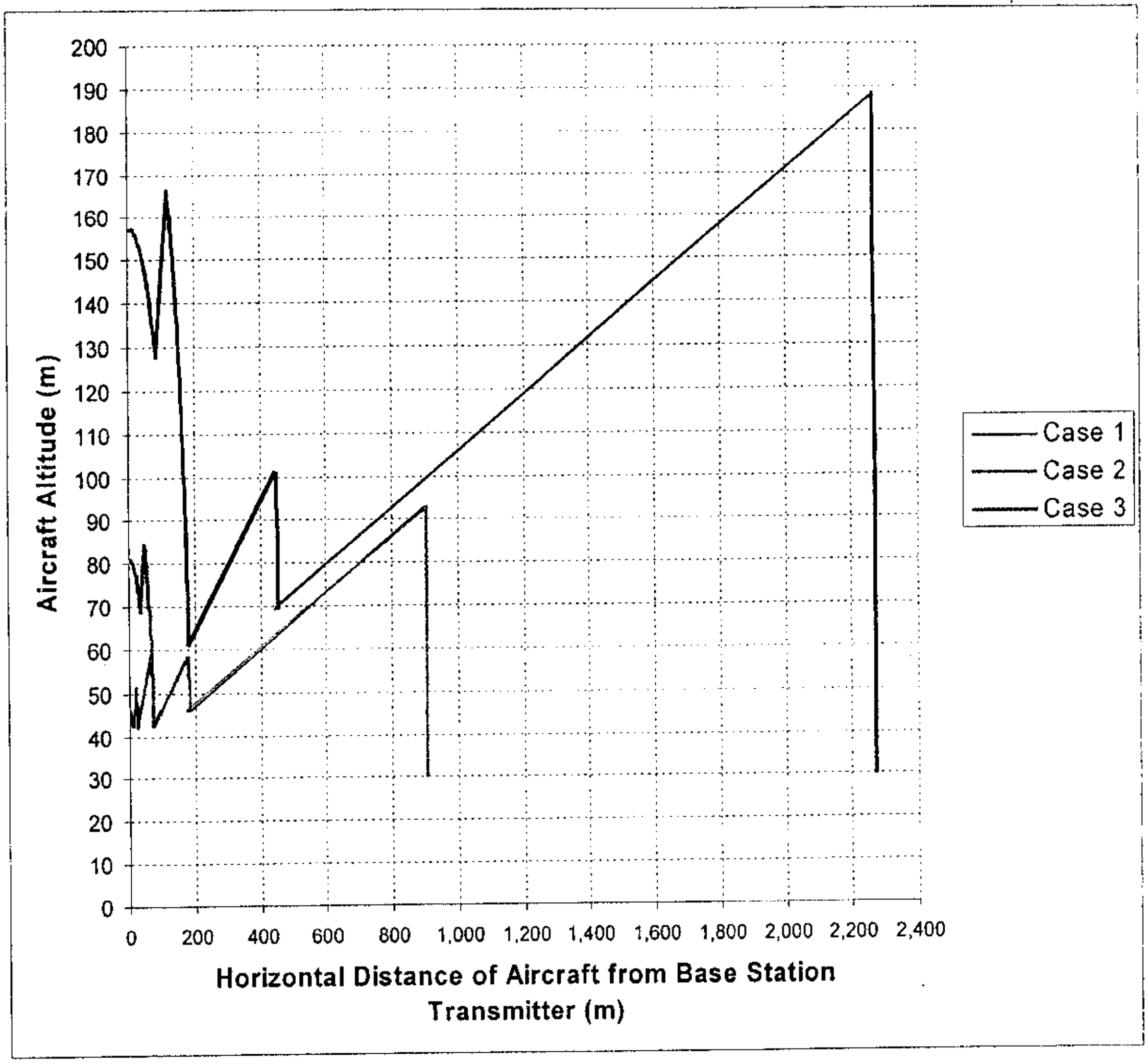
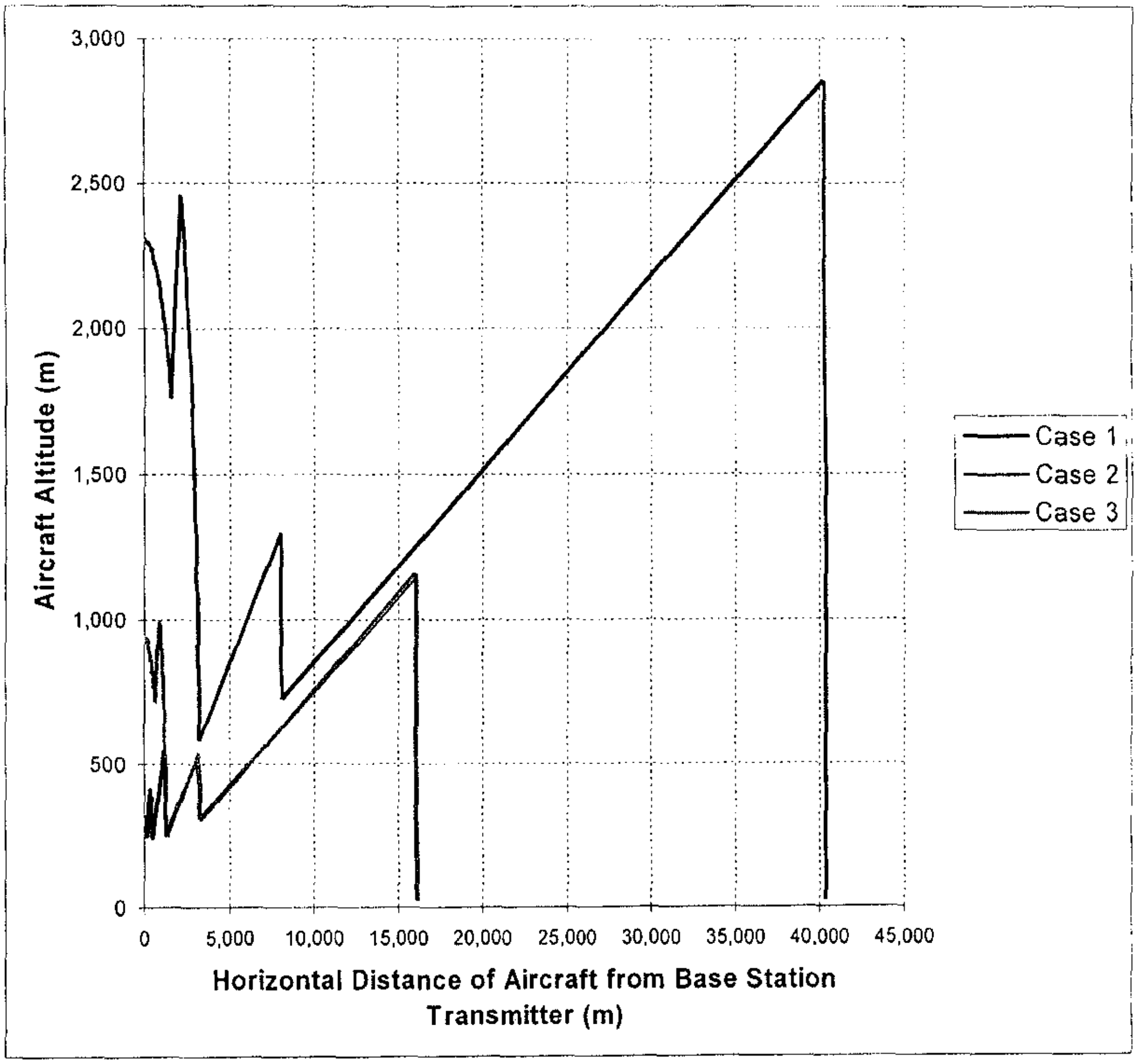


Figure 3: Impact of Relaxing the Overhead Gain Suppression of the ATC Base Stations, and Increasing its EIRP by 8 dB, on the Safe Distance of an Aircraft from the ATC Base Station (-75 dBm interference threshold)



The Bureau was wrong that, under "very conservative" studies, increasing ATC base station EIRP by 8 dB would have only a small impact on the zone around an ATC base station where an MET would be subject to overload or intermodulation product interference.[16] In particular, the Bureau concluded that the minimum separation distance for Inmarsat land-based METs will increase from 100 meters to just over 200 meters, as a result of the 8 dB increase in the ATC base station EIRP limit (based on the –60 dBm overload threshold assumed by the Bureau for land based Inmarsat terminals).[17] The Bureau argued that this increase is unlikely to result in interference issues.

16 *MSV Order* at ¶ 81.
17 *Id.*

This is wrong for a number of reasons. Inmarsat land mobile terminals are currently used in urban areas where the Commission anticipates ATC will be deployed, and this circumstance is even more likely to exist with the roll-out of Inmarsat's forthcoming BGAN service, which will offer a more robust and more attractive land mobile service than ever before. Second, the Bureau's analysis is based on flawed propagation assumptions.

As an initial matter, the analysis to which the Bureau refers in the *ATC Order* that established an ATC base station separation distance of 100 meters assumed a propagation model that was not fully explained, but which involved 10 dB more attenuation (at 100 meters) than a line-of-sight model, which would be the appropriate model to use in many of the cases where ATC may be deployed. There is simply no basis to assume that "most ATC base stations are likely to be in urban areas in order to boost MSV's weak satellite signals."[18] There is no limitation in the ATC rules about where ATC can be deployed, and MSV is not restricted in its license to deploying ATC only in urban areas. Moreover, one need only to look around the greater Washington DC metropolitan area---an urban area for US census purposes – to realize that the term "urban" compasses many areas where a clear line of sight to an ATC base station is very likely to occur – particularly in areas such as Fairfax County and Montgomery County where ATC roll out appears feasible.

Thus, is establishing the likely exclusion zones around ATC base stations, use of a line-of-sight propagation model is perfectly appropriate for many situations involving such short distances as 100 meters. Indeed, Industry Canada recognized the propriety of considering free space propagation characteristics in an analogous situation---assessing the interference impact of DARS terrestrial repeaters into terrestrial wireless networks, and for separation distances from a few hundred meters to several kilometers.[19] Using free space propagation characteristics, the interference margin for an Inmarsat terminal at 100 m distance from an ATC base station would change from +1.8 dB to –8 dB, and the separation distance would increase to up to 250 meters from an ATC base station, using the Commission's own analysis. Hence, there is a risk of harmful interference around an ATC base station even if the base station EIRP limit is not changed.

Taking into account the 8 dB increase in ATC base station EIRP, there would be a -16 dB (*negative*) margin at the receiver in free space conditions, corresponding to a separation distance of over 600 m.[20] This represents a significant increase in the interference to which Inmarsat will be subject as a result of ATC deployment, and it is fundamentally inconsistent with the principles in the *ATC Order*, which established a secondary terrestrial service in the L-band, while establishing a carefully crafted set of interference protections for the primary MSS. Based

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18 *Id.*

19 *A Staff Study on the Potential Impact of Satellite Digital Audio Radio Services Terrestrial Repeaters on Wireless Communications Service Receivers Operating in the Adjacent Band at 2.3 GHz*, Industry Canada at 3 (Dec. 2003) (*available* at http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/vwapj/dars_e.pdf/$FILE/dars_e.pdf).

20 If the Inmarsat threshold value of -75 dBm is used this negative margin increases to -31 dB. Clearly, at such a margin, Inmarsat's land-based terminals would be seriously impacted by the ATC base stations, and would not be able to operate anywhere in the vicinity of them, even in urban areas. However, Inmarsat assumes that the Commission would adjust the base station EIRP limit accordingly, if it finds that the interference threshold is different from –60 dBm.

on the points discussed in the previous paragraphs, Inmarsat urges the Commission to reverse the Bureau's decision to relax the EIRP limits on ATC base stations by 8 dB.

A key factor in determining the interference threshold of Inmarsat receivers is the intermodulation interference resulting from two or more transmitted carriers of the ATC base station that produce intermodulation products that may fall in the pass-band of the Inmarsat receiver, due to receiver nonlinearities. The Bureau rightly pointed out that its proposed 8 dB relaxation in ATC base station limits will exacerbate this problem.[21] However, the Bureau simply left this significant interference effect for resolution by a commercial negotiation between MSV and Inmarsat.

This approach is unsatisfactory. Inmarsat needs to have the ability to use all its frequencies across the entire coverage of its system, which includes areas near ATC base stations. Hence, no burden can be put on Inmarsat to avoid certain frequencies to accommodate interference from MSV ATC intermodulation products. In theory, the FCC could put a requirement on MSV to make sure that no ATC carriers are deployed that form IM products in Inmarsat spectrum. However, there is no reason for MSV to cooperate by selecting base station carrier frequencies in a way that might reduce the chance of intermodulation products falling within Inmarsat receive bands. Intermodulation interference should be accounted for in the FCC tests of Inmarsat terminals and hence in the assumed interference threshold, and the ATC limits should be adjusted according to the results of those tests to ensure that the potential for interference to Inmarsat terminals is maintained at an acceptably low level.

2. <u>Uplink Interference Issues</u>

2.1. <u>Link Margin for Structural Attenuation</u>

The Bureau stated that it believed that MSV had complied with the ATC rules regarding the 18 dB structural attenuation factor.[22] The Bureau dismissed Inmarsat's request that MSV demonstrate that ATC mobile terminals operated outdoors never use an EIRP greater than –18 dBW and stated that the underlying intention of the 18 dB requirement was to bar licensees from extending a base station's coverage area to such an extent that a mobile terminal at the edge of the area would have to transmit at an EIRP higher than –18 dBW merely to overcome free space path loss.[23] The consequence of this new interpretation is to allow MSV to cause additional interference to Inmarsat satellites, as discussed below.

The 18 dB structural attenuation requirement is needed to ensure that the 20 dB power control factor assumed in the FCC's interference analysis in the *ATC Order* is valid. To put it another way: the FCC assumed that the *average equivalent outdoor EIRP* of all ATC mobile terminals is not above -20 dBW, as clearly shown in Table 2.1.1.A in the *ATC Order*.[24]

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21 *MSV Order* at ¶ 82.

22 *Id.* at ¶ 31-32

23 *Id.*

24 In the referenced table the "Power Control Factor" value of 20 dB is used to reduce the average effective EIRP to a value of 0 dBW minus 20 dB = -20 dBW. This averaging is meant to take into account the power control effects necessary to address range compensation, structural attenuation and body absorption. *ATC Order* at 2152 (Appendix C2 § 1.3.5)

As discussed in the *ATC Order*[25], this average equivalent outdoor EIRP is the same regardless of whether the MT is operated outdoors, indoors, in a car or in any other location.

Clearly, the actual equivalent outdoor EIRP of different MTs will vary depending on the MTs operational conditions, i.e. mainly its location with respect to the ATC base station. For example, the requirement referred to above means that MTs at the edge of a cell with line-of-sight to the base station will have an equivalent outdoor EIRP of –18 dBW (or less). MTs inside a cell (but still in line-of-sight conditions) will have somewhat lower equivalent outdoor EIRP. Furthermore, particularly in urban environments, there is a high probability that MTs used outdoors are fully or partially blocked from the ATC base station. It should be noted that also indoor MTs and MTs operated in cars may be subject to additional blockage towards the base station. These situations are illustrated in the diagram below. The critical issue is to ensure that the average equivalent outdoor EIRP for **all** ATC MTs operating on the same frequency is -20 dBW or lower.

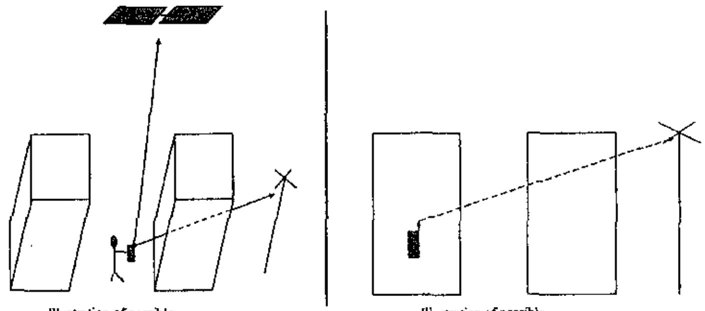

Illustration of possible blockage of outdoor MT

Illustration of possible blockage of indoor MT

In the situation shown in the diagram above, the MT may have to operate at full EIRP to close the link to the base station. In the case of outdoor MTs, as shown in the left part of the diagram above, and taking into account the MT antenna pattern supplied by MSV, the EIRP towards the Inmarsat satellite would then be -4 dBW. This situation would only need to exist simultaneously, at the same frequency, 69 times across the entire USA, to cause the equivalent interference of 1,725 frequency re-uses under the conditions assumed in the Commission's uplink interference analysis as contained in the *ATC Order*. Furthermore, it is apparent from the diagram above that the interference potential from these particular MTs could be even greater than that. If the 3.1 dB outdoor blockage does not apply to these particular MTs, the situation would only need to exist 34 times to cause the same interference level.

Of course, there are likely to be many intermediate situations, where MTs are partially blocked from the base station and need to operate at an equivalent outdoor EIRP somewhere between –20 dBW and -4 dBW. The average amount of signal blockage from outdoor user locations (and equivalent outdoor user locations for MTs in buildings and cars) would need to be determined to establish the interference impact on Inmarsat satellites. Fortunately, the Commission has provided all the data necessary to assess this when it addressed the effect of elevation angles on the average outdoor blockage in the *ATC* Order.[26] The

25 *ATC Order* at 2151 (Appendix C2 § 1.3.1).

26 *Id.* At 2146-2148 (Appendix C2 Figure 1.2.2.C, § 1.2.3).

Commission established the expected average outdoor blockage towards different satellites, ranging from 0.5 dB towards the MSV satellite at 101°W (at about 43°elevation) to 17.5 dB towards AOR-E (at about 12° elevation).[27] Although this blockage data was used to assess the signal blockage between MTs and various satellite positions in the sky, it can also be applied to assess the signal blockage between the MT and the ATC base station. Since base stations are generally at very low elevation angles (comparable to 12° or less), the FCC data indicates that the average outdoor blockage from mobile terminals towards the ATC base station would be in the region of 17.5 dB.[28]

To work out the average equivalent outdoor EIRP of all MTs, we need to understand a bit more about the distribution of EIRP levels for different MTs in the system. In para 29 of the MSV licensing order the FCC states that MSV has asserted "that when a mobile terminal's line-of-sight propagation path to a base station is unobstructed, its signal power will be reduced by a closed-loop power-control algorithm, implemented in the base station and the mobile terminal, to an average level 18 dB lower than its maximum power". Since the EIRP of an MT is assumed to be -4 dBW (when averaged spatially), this assertion by MSV means that the average EIRP of all MTs in LOS conditions will be -22 dBW. To this value we need to add the average blockage from the MT to the base station to derive the average equivalent outdoor EIRP for all MTs, taking into account that the EIRP of any MT is –4 dBW (when averaged spatially). The following table provides the calculation, using additional assumptions taken from the ATC Order.

User Location	Outdoor	In Car	In Building
Structural attenuation (dB)	0	7	18
Average EIRP in LOS conditions (dBW)	-22	-15	-4
Equivalent outdoor EIRP in LOS conditions (dBW)	-22	-22	-22
Average outdoor blockage (dB)	17.5	17.5	17.5
Average MT EIRP for all MTs (dBW)	-4.5	-4	-4
Average equivalent outdoor EIRP for all MTs (dBW)	-4.5	-11	-22
Percentage of population (%)	30	30	40
Weighted average outdoor EIRP (W)	0.106	0.024	0.003
Weighted average equivalent outdoor EIRP (dBW)		**-8.8**	
Assumed average equivalent outdoor EIRP (dBW)		**-20**	
Interference excess (dB)		**11.2**	

As shown in the above table, with the assumptions discussed above (all of which are taken from the *ATC Order* and the *MSV Order*), and also assuming that an outdoor terminal is not constrained in its maximum output power beyond 0 dBW, the level of interference to the Inmarsat satellite would exceed by about 11 dB that prescribed in the ATC Order.

The above calculation illustrates the critical issue that Inmarsat has raised in the past and that the Bureau has ignored in its Order authorizing MSV, viz. that the 18 dB structural attenuation rule needs to be clarified and MSV has to be required to demonstrate and commit to some mechanism that will overcome this problem. Unless the Commission requires MSV to

27 *Id.* at 2148 (Appendix C2 § 1.2.3).

28 Note that the value is dependent on the elevation angle, and could be considerable more than 17.5 dB for elevation angles lower than 12°.

provide evidence that its ATC system is designed to maintain an average equivalent outdoor EIRP of less than -20 dBW, there is no assurance that Inmarsat will be protected from ATC interference. Inmarsat believes that the only feasible way of achieving this is to limit the peak EIRP of outdoor terminals to −18 dBW, in line with Inmarsat's interpretation of the rule.

Moreover, the Commission addressed the situation of ATC base stations located at the periphery of the ATC service area, as far as compliance with the 18 dB factor is concerned. Initially, the Commission rightly pointed out that MSV "*... describes methods for configuring base stations at the periphery of an ATC service area ...*", but then goes on to suggest that MSV has *committed* to these measures.[29] Inmarsat asserts that MSV has provided no such commitment about how it will configure its base stations to comply with the 18 dB requirement at the periphery of the ATC service area, but rather has simply discussed *possible* measures that could be employed. This lack of commitment from MSV is very significant and needs to be addressed by the Commission.

2.2. Mobile Terminal Antenna Gain

The Bureau granted MSV a 4 dB relaxation of the co-channel reuse limit by accepting MSV's claim that an *average* MT antenna gain of −4 dBi should be used in the interference calculations instead of the 0 dBi *peak* antenna gain specified in the ATC rules.

Inmarsat fully understands that the aggregate interference impact is determined by the average MT EIRP in the direction of the Inmarsat satellite. However, this issue cannot be considered in isolation. Altering or waiving one ATC parameter affects the margin available to accommodate other variables in the ATC interference scenario. Thus, a "piecemeal" change of certain ATC limits raises the risk of inadequately accommodating other aspects of the interference case that may be different than the Commission has assumed in the *ATC Order*.

As the Commission's ATC interference analysis has a number of assumptions with varying degrees of uncertainty, it is appropriate to maintain some conservatism in specifying the limits on ATC. The Commission has recognized this uncertainty, as evidenced by the requirement to phase in ATC deployment over a period of time. It is therefore appropriate to retain the current reuse limit, to ensure that the Inmarsat system will operate without harmful interference.

There are a number of variables in the interference analysis that could give rise to under-estimates of the interference experienced by Inmarsat, and therefore may offset any actually realized reduction in average ATC mobile terminal gain:

1. The location of the affected Inmarsat satellite.

The Commission based its analysis on the assumption that Inmarsat will operate an Inmarsat-4 satellite at 54°W.[30] Two parameters in the Commission's analysis follow from

29 *MSV Order* at ¶ 30.

30 *ATC Order* at 2159 (Appendix C2 § 1.11).

this assumption – first that the free space path loss from CONUS to the Inmarsat satellite (in the uplink band) will be 188.7 dB, and secondly that the outdoor blockage factor will be 3.1 dB.

Inmarsat has ITU filings for next-generation MSS spacecraft also at 98°W and 104°W. Since those locations are close to the MSV location of 101°W, the effect on the interference analysis would be that the free space path loss becomes 188.3 dB and the outdoor blockage factor becomes 0.5 dB. Hence, the aggregate effect of ATC interference would increase by 3.0 dB.

2. Inmarsat-4 antenna discrimination

The Commission's assumption of 25 dB Inmarsat-4 antenna discrimination is based on the assumption that this is the minimum antenna discrimination required to achieve frequency reuse between MSV and Inmarsat-4.[31] The beam used by the Commission to derive the average antenna isolation is only one of many Inmarsat-4 beams, each with a different gain contour. These different beams therefore would produce different average gain across CONUS.

More fundamentally, the assumption made by the Commission that 25 dB antenna isolation is required to achieve coordination between MSV and Inmarsat-4 is not necessarily the case. Coordination between MSV and Inmarsat-4 has not been completed and may yield a different result to that assumed by the Commission. If it is found that sharing is possible at lower isolation, the impact of ATC interference would increase. Several factors affect this result, such as the actual operational MET power levels in the MSV system, and the actual number of frequency reuses within the MSV satellite system.

Furthermore, the average antenna gain does not factor in the effect of the distribution of ATC users. If relatively more ATC users were located in the areas of the spot beam gain contour which has less discrimination, the average isolation towards the ATC users would be reduced.

Hence, there are uncertainties in the interference calculations that warrant maintaining a conservative approach to ensure that Inmarsat's services are not affected. Specifically, to provide some latitude that accounts for these variables, it is appropriate to base ATC reuse calculations on a 0 dBi *peak* antenna gain.

Therefore, it is inappropriate for the Bureau to refine its interference assessment taking into account only the factors that favor MSV. If a renewed approach to the interference analysis is to be taken, then it must include a range of other issues, such as those highlighted above, which will negate, and possibly outweigh, the advantages of the use of an *average* MT antenna gain. We therefore urge the Bureau not to relax the re-use limit based on the new approach of using the *average* MT antenna gain instead of the *peak* antenna gain, which was used throughout the ATC rulemaking.

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31 *Id.*

Appendix B

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STRATOS BEYOND THE HORIZON

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News Releases

Fire Department of the City of New York (FDNY) Selects Stratos for Emergency Response Communications

Satellite-based technology provides reliable on-the-scene video, voice and data communications in situations where traditional networks are unavailable or overwhelmed

BETHESDA, MD (October 12, 2004) - Stratos Global Corp. (TSX: SGB), a leading global communications provider and the world's leading distributor of Inmarsat satellite services, today announced it has been chosen by the Fire Department of the City of New York (FDNY) to provide satellite-based emergency response communications, including vehicular and mobile terminals for the dependable transmission of video and voice communications between on-the-scene responders and headquarters locations. The selection follows Stratos' successful technology demonstration for FDNY's field and command center units.

Because they are independent of terrestrial and cellular communications networks, Stratos' satellite-based solutions are particularly advantageous in emergency response situations when traditional technologies may be either unavailable or overwhelmed. FDNY will primarily use the technology to facilitate video conferencing between on-the-scene responders and headquarters personnel.

The contract with FDNY includes the purchase of mobile and vehicular satellite terminals using Inmarsat GAN (Global Area Network) technology, video conferencing units, and laptop computers, as well as systems integration and ongoing service. Mobile and vehicular GAN terminals installed in response vehicles are fully integrated with FDNY's command center at MetroTech in Brooklyn. Stratos' partners in this effort include DVLaptop Inc., EMS Technologies, Global Communications Solutions, and LiveWorks Ltd.

"Recent events, such as those on September 11, 2001, have demonstrated that traditional land-based and cellular communications networks are not always reliable during an emergency," said Jim Parm, Stratos' president and chief executive officer. "Stratos' satellite-based solutions provide a reliable, go-anywhere technology that can travel to the scene of an emergency and provide emergency response teams with the secure and dependable communications capabilities they require, regardless of the status of terrestrial and cellular networks.

"Our technology has proven reliable and effective in the most challenging situations, including with the U.S. military during operations in Iraq," added Parm. "We're pleased to be providing this field-proven communications capability to the Fire Department of the

City of New York, and we look forward to working with other federal, state and local agencies on critical applications for homeland security and emergency response."

The Inmarsat GAN mobile satellite solution being provided by Stratos uses either a roof-top dome or a lightweight portable antenna, approximately the size of a laptop computer, to provide up to 64 kbps of throughput for Internet and e-mail access, fax, large file transfers, video conferencing and high-resolution image transfer. Users can choose GAN's Mobile ISDN service for quick transfer of large data files or Mobile Packet Data Service (MPDS) for "bursty" data applications, such as Internet and e-mail. GAN coverage is available worldwide, across all major land masses, with the exception of the extreme polar regions.

About Stratos
Stratos Global Corp. (www.stratosglobal.com) is a publicly traded company (TSX: SGB) and leading international telecommunications services provider offering customers operating in remote locations a variety of satellite and microwave wireless technologies to provide Internet Protocol, data, and voice solutions through a range of newly emerging and established technologies such as Inmarsat®, Intelsat®, Iridium®, Globalstar®, VSAT, and others. Stratos serves an array of diverse markets including government, military, oil and gas, maritime, industrial, aeronautical, media and recreational users anywhere in the world.

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CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing submission, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted therein, and that it is complete and accurate to the best of my knowledge and belief.

Name: Jonas Eneberg
Title: Manager
Spectrum Regulatory Affairs
Inmarsat

Dated: December 8, 2004

CERTIFICATE OF SERVICE

I, Thomas A. Allen, hereby certify that on this 8th day of December, 2004, the foregoing "Application for Review" was served by hand(*) or via first class mail, postage pre-paid, upon the following:

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